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NEW HAMPSHIRE
AGRICULTURAL EXPERIMENT STATION

DEPARTMENT OF DAIRYING

A Study of Farm Buttermaking IN New Hampshire.

BY FRED RASMUSSEN

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND MECHANIC ARTS
DURHAM, N. H.

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A STUDY OF FARM BUTTERMAKING IN NEW HAMPSHIRE.

Introduction.—According to the last census report 143,981,000 pounds of milk is made into butter yearly on New Hampshire farms. With an average test of four per cent. this amount of milk would contain 5,759,240 pounds of butter fat from which 6, 719,113 pounds of butter can be made, figuring one and one-sixth pounds of butter to each pound of butter fat. At 28.5 cents per pound of butter the total value of farm butter amounts to $1,914,947.21.

CONDITIONS FAVORABLE TO FARM BUTTER-MAKING.

It is generally accepted that the days of farm butter-making are passed within the shipping zones of large cities. Undoubtedly there has been a decrease in the amount of farm butter made in New Hampshire since the last census, but nevertheless a large amount is still being made, due to the following conditions:

1. Location of Farm.—In some sections many farms are located at considerable distances from a railroad. This makes the transportation of milk for the market very difficult if not prohibitory, especially if the roads are stony and hilly, and if there are no creameries or cheese factories in the locality, the milk and cream is most commonly made into butter on the farm.

2. Closing of the Creameries.—Due to an increased demand for milk for city consumption many of the creameries in the state have either been bought or forced out of business by the milk contractors. Often the creameries were located at a distance from the railroad station. The result was that many farmers living on the opposite side of the creamery from the railroad station found the distance too great for daily transportation of milk to the station, and therefore either gave up keeping cows or began to make butter on the farm. Many smaller creameries have failed, due to poor management and lack of coöperation or confidence in the enterprise. In sections where creameries have failed a suspicion has sometimes prevailed among the farmers that they had been cheated in the butter fat test, and could get more out of their cream and milk by making it into butter on the farm.

3. Breed of Cows.—Farmers having Jersey and Guernsey herds as a rule find it more profitable to sell cream or make butter than to sell milk unless they can obtain a special price for their milk.

4. Small Herds.—There are a great many farms in New Hampshire keeping from one to five cows. Altho each of them does not furnish a large quantity of butter a very large part of the total made in New Hampshire is made from such herds. Unless near the railroad station many of these small producers seem to prefer to make their product into butter.

5. Special Market.—The good opportunity for creating and finding special markets at 35 to 40 cents per pound of butter thruout the year induces many farmers to make butter. In places there is also a very ready sale for both skim milk and butter-milk at 15 to 20 cents a can which adds considerable to the profit.

6. Miscellaneous.—In addition to the reasons already given, many farmers were found making butter on the farm because of the value of the skim milk and butter-milk for raising calves, hogs and for feeding chickens; others were too independent or for other reasons would not market their milk thru the contractor, even where a market was available, and others because the sale of butter removes the least fertility from the farm. Some farmers during the summer boarder season find an excellent market for their milk and cream and prefer to make butter the rest of the year in preference to selling their milk under a yearly contract.

INFORMATION SECURED FROM GRANGES.

In order to obtain a general idea of the extent of farm butter-making in various parts of the state, the coöperation of the granges was asked for to the extent of giving names of farmers making butter within their respective territories.

A circular letter enclosing return postal cards was sent to 286 granges in the state. In all, 142 Granges or 50 per cent. answered the correspondence.

The cards received contained the names of 551 farmers making butter. In addition to the names the following information as tabulated below was obtained:

TABLE I.— *Information concerning dairy conditions received from Granges.*

Counties.	No. of towns recorded.	No. of butter makers	Demand for dairy butter.	Range in price per pound.	Average price per pound.	Dairying increasing in	Dairying normal in	Dairying decreasing in	Principal reasons for increase.	Principal reasons for decrease.
Belknap.....	7	44	Good.	$0.25- $0.32	$0.30	3	....	2	Better butter produced; pure bred bulls; creamery established.	
Carroll.....	6	27	Fair..	.25- .30	.27	2	1	....	Better grade cows; raising own grain.	
Cheshire.....	14	72	Good.	.20- .32	.30	4	3	6	Large amount of milk shipped.	Cost of grain; failing pastures; poor grade bulls; raising sheep; farms being sold.
Coös.....	14	55	Good.	.20- .30	.25	9	1	....	Cheese factory established; milk in demand for Boston markets.	
Grafton...	22	76	Fair..	.22- .35	.28	11	1	5	Increased fertility of soil; creameries; price of butter; help more plenty; good milk market.	Cost of grain; poor pastures; lack of interest.
Hillsborough..	18	37	Good.	.25- .35	.30	2	3	11	Demand for milk.	Price of grain; low price of milk; high cost of labor.
Merrimack.....	19	83	Good.	.22- .35	.28	7	4	3	Good demand for milk; high prices, creamery being started.	High price and scarcity of help; unsatisfactory relations between milk contractor and farmer.
Rockingham...	21	64	Good.	.25- .35	.30	4	8	5	Better price of milk.	Poor market; cost of grain.
Strafford.....	8	36	Good.	.25- .30	.28	1	2	2	Better demand for butter; introduction of cream separators.	Cost of grain; unsatisfactory relations between milk contractor and farmer.
Sullivan.....	11	57	Good.	.20- .30	.25	1	4	3	Dairy butter preferred to creamery.	Cost of grain; labor scarce and high.
	140	551	Good.	$0.20-$0.35	$0.28	44	27	37		

It should be understood that the reasons given for the increase and the decrease in dairying are local reasons and may not represent the existing conditions in the whole county. In general, however, it is safe to infer from the above table that the demand for milk from Boston and other large cities which also has resulted in a better local market for butter, especially dairy butter, is the principal reason for an increase in dairying, while the high cost of grain and the scarcity of labor are the main factors causing a decrease.

INFORMATION OBTAINED FROM INDIVIDUALS.

A circular letter explaining the information asked for on an enclosed return post card was sent to the 551 farmers making butter whose names had been obtained thru correspondence with the granges.

Ninety-six, or 17.4 per cent. answered the questions and the following information in regard to the extent of operations and method of marketing was obtained:

Number of churnings per week.

Churnings per week,	1	2	3	4	5	Unreported
Farmers reporting,	23	52	10	3	1	7

Amount of butter made per week.

Amount made on 90 farms.	Largest amount.	Smallest amount.	Average for 90 farms.
5271 lbs.	500 lbs.	7 lbs.	58.5 lbs.

Method of disposing of the product.

	Sold to stores	Sold to private trade	Unreported	Shipped	Delivered	Packed in				Unreported
						tubs	jars	boxes	prints	
Farmers	by 32	by 68	by 8	by 9	by 41	by 1	by 1	by 3	by 88	by 3

Demand and price received for dairy butter.

	Relation of demand to supply.				Price received.		
	Greater	Not greater	Equal	Variable	Highest	Lowest	Average
Farmers reported	72	9	2	1	$0.40	$0.22	$0.28

It will be noted that the price of butter as reported by granges varies from 20 to 35 cents a pound and as reported by individuals from 22 to 40 cents. In comparing these prices with the average price obtained from statistics gathered in the field work very little difference was found.

Average price per pound of butter.

As reported by 116 granges	As reported by 96 individuals	As shown by field statistics
$0.283	$0.281	$0.285

In order to figure accurately the average price for the state it would, of course, be necessary to know the amount sold at the different prices thruout the year. The summer prices generally range from 25 to 35, and the winter price from 30 to 40 cents per pound. The cases reported and observed where butter has been sold for less than 25 cents a pound are comparatively few and it has been due either to an inferior article or to a surplus of butter in the local market. Few of the farmers receive as high as forty cents.

Considering these factors and the small difference found in the average obtained from three different sources, it is believed that 28.5 cents very nearly represents the average price for farm butter in New Hampshire.

After having obtained thru correspondence a general idea of the dairy conditions in different sections of the state, and also having had from several farmers in each section an expression of willingness to coöperate with the Station, it was thought desirable to place a man in the field to obtain more detailed informa-

tion. To assist in this work, the services of Mr. John Daniel, a graduate of Massachusetts Agricultural College, were secured. Over 100 farms in different parts of the State have been visited. Information has been gathered on methods of dairy farming, farm butter-making and other dairy problems.

The discussion in this bulletin is restricted to farm butter-making, of which a special study was made. It is hoped by pointing out the conditions found, and at the same time discussing the important factors in farm butter-making, that this bulletin may be of value in correcting some of the most common faulty practices.

EQUIPMENT FOR FARM BUTTER-MAKING.

EQUIPMENT ON FARMS VISITED.

The greater part of the farm butter in New Hampshire is made by farmers who own small herds and who make from twenty-five to sixty pounds per week. With a business of this extent, it would not be expected to find any very expensive equipment. It would seem profitable and necessary, however, for farmers making from sixty pounds to as high as three hundred pounds of butter per week, to have a special building or at least a special dairy room, and yet less than eight per cent. of the farms visited had any special place and few had a regularly equipped dairy. One had a special building, not large, but neat and attractive and adequate for all purposes. Seven had rooms in other buildings fitted up with complete equipment.

The small producer can hardly afford to build a special building, but it is entirely practical and profitable to fit up a room either in the house or in some shed and keep this solely for butter-making. Such a room should be clean, well lighted and ventilated, and if possible should have the entrance from the outside.

A general plan of operation on many farms where no special place for making butter is provided is to bring the churn into the kitchen, which often is used both for a ripening and churning room. The kitchen is not a desirable place to make butter, as it generally is too warm, causing the butter to become soft very quickly, and if worked in that condition it never has as good appearance and texture as butter which has been worked while firm and granular.

Apart from this effect upon the butter and the discomfort of working in a hot room, the quality of the butter is often further impaired by the absorption of food flavors.

GROUND PLAN OF FARM DAIRY FOR 20 COWS.

When constructing a dairy building efforts should be made to make it as sanitary as possible. It is impossible to recommend a definite material of construction as the best for everybody, for what would be the better in one locality might be impractical and uneconomical to use in another. Cement, either concrete or cement stucco finish, brick, terra cotta tile, or stone, are much to be preferred for the walls to lumber. As little wood as possible should be used in places frequently exposed to water. If for any reason it would seem more expedient after considering cost of material mentioned to build a wooden building, the floors at least should be made of cement, as cement floors are much more sanitary, more durable

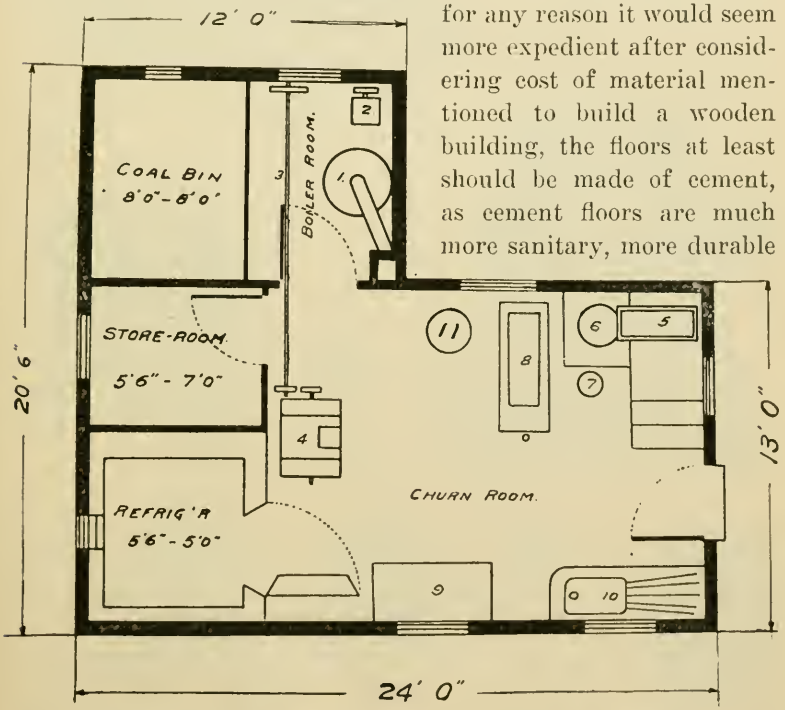

Fig. 1. Floor plan of dairy for 20 or more cows, showing convenient arrangement of machinery.

1. Boiler; 2. Engine; 3. Shaft; 4. Combined Churn and Butter Worker; 5. Milk Vat; 6. Separator; 7. Skim Milk Can; 8. Cream Vat; 9. Printing Table; 10. Wash Sink; 11. Babcock Tester.

and easier to keep clean than wooden floors. The inside walls should have a plain smooth finish with coved or rounded corners if possible.

Figure 1 shows a plan of a farm dairy which is suggested as practical, convenient and within the reach of the average farmer having a herd of 20 or more cows. The cost of such a building as estimated by a local contractor need not exceed $500, and may be built cheaper if sand and gravel can be had near the building site, or if the lumber can be cut on the farm and part of the labor furnished by farm hands. With a stone or cement foundation, even if the rest of the building is made of wood, it will last a life time, eliminating accidents from fire and storm. A herd of 20 cows averaging 280 pounds butter per cow per year, which is considered a minimum production for a profitable and economical herd, would produce a total of 5600 pounds per year. Figuring the building to be serviceable for 40 years, in that time 224,000 pounds of butter would have been made in the building. The cost of the building would therefore only add .22 of a cent to the cost of making a pound of butter. If no special building is available for making the butter, a place must be provided somewhere for making the butter, hence the increased cost due to the building would be less than .22 cents as it should be figured on the difference between the cost of a separate building and the cost of providing some other place to handle the milk and make the butter. Considering the many advantages and conveniences a special building affords, no one expecting permanently to take up farm butter-making can afford to be without it.

Location of Dairy.—The dairy should be located so as to be free from contaminating surroundings, such as stable yards, pig pens, poultry houses, or open ditches. The location should have good natural drainage and the building have an artificial drain to carry away the water used in the dairy and the water from the ice in the refrigerator. An open ditch leading away from a dairy is very undesirable as it offers a very favorable breeding place for insects and bacteria and also gives off undesirable odors.

COST OF EQUIPMENT.

The equipment and therefore the cost of equipment for butter-making, apart from the dairy room or building itself, varies

considerably. The lowest estimate recorded was $15. The equipment in this case consisted of a large churn used for churning whole milk and a wooden butter bowl and paddle. The highest cost of equipment was $600, obtained from the owner of one of the special rooms equipped with a power separator and

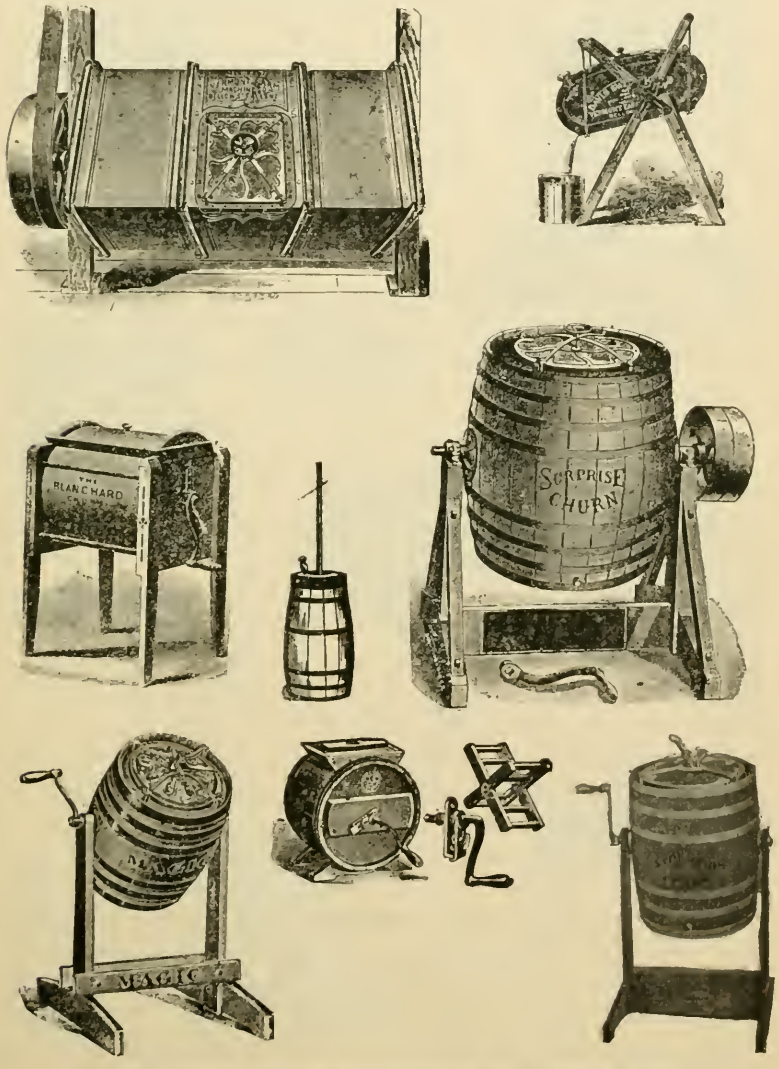

Fig. 2. Types of churns in daily use on New Hampshire farms.

churn, butter worker, cream vat, boiler and engine and a number of smaller utensils. The average cost of equipment of dairies visited was $175. The most common equipment will not come to this average, consisting as it does of a separator of 400–600 pounds capacity, a barrel or swing churn of from 20 to 60 pounds capacity, a worker of about the same relative size, a Babcock tester and a few smaller utensils. The cost of such an equipment is between $90 and $150 depending on the sizes of the apparatus. In a dairy lately equipped with a separator, 900 pounds capacity, and a combined churn and butter worker of 60 pounds capacity, an engine, necessary shafting, belt and all smaller articles such as butter mould, butter papers, etc., the total cost was $307.

To have good equipment is important to make a success of butter-making. It makes it possible to do more rapid and efficient work, to do it easier and to make a better quality of butter. Furthermore, it adds to the attractiveness of and increases the interest in the work. During the last year several large farm dairies in the state have been equipped with combined churns. The advantage of this churn over a separate churn and a separate worker is that it saves the labor of removing the butter from the churn and handling it during working. The butter is worked in this churn without being exposed to the air, thus protecting it from dust and possibly flies and from being subjected to rapid changes in temperature. In creamery butter-making, the combined churn has for several years established its superiority over the box churn, but apparently has, until recently, been considered impractical for farm dairies. Although it cannot be recommended in all cases where butter is made, it undoubtedly will prove convenient and profitable in dairies making 75 pounds or more of butter per week.

POWER.

The kind of power to provide for the farm dairy is a question upon which it is often difficult to decide. Of the farms visited where power was used five were using tread power, four gasoline engines, one a steam engine and one a water motor. Although electric power was not found in any of the dairies, wherever available it should be considered, as it makes a very desirable and

cheap power. As conditions vary on different farms, each individual must choose for himself the power which seems best suited to the conditions. In comparing the relative cost of the various powers mentioned, with the intial cost and the running expenses,

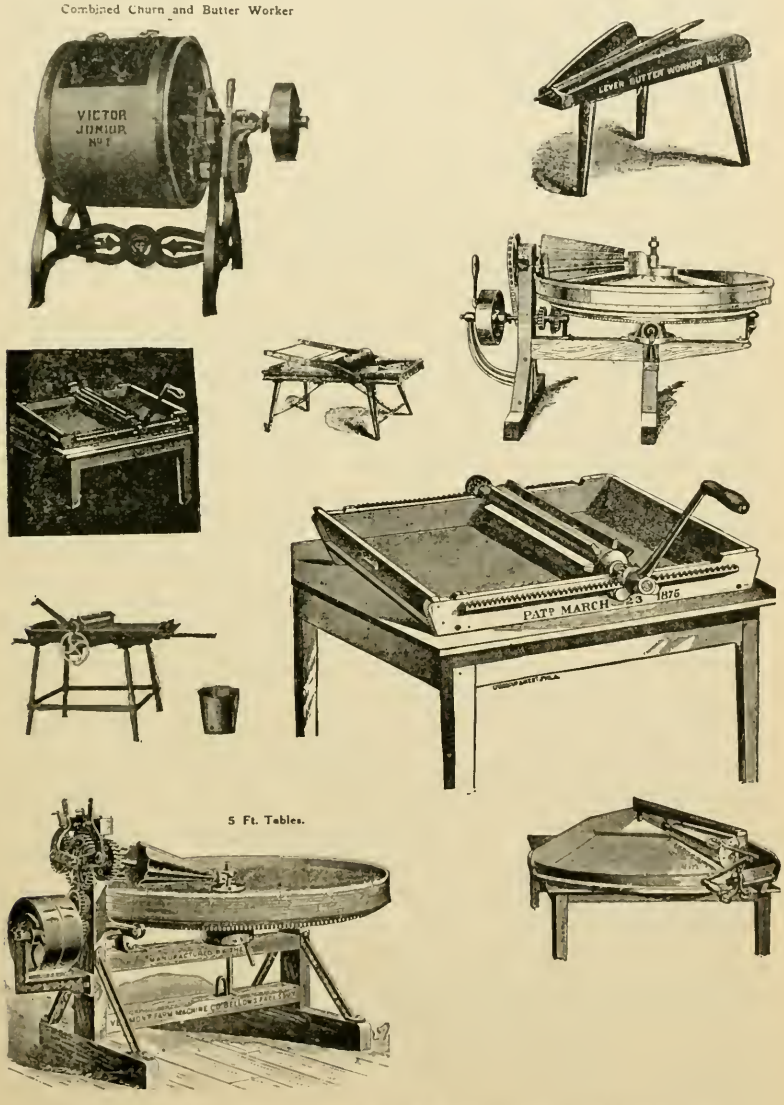

Fig. 3. Types of butter workers in daily use on New Hampshire farms.

it should be remembered that with all except the steam engine and boiler additional equipment must be provided for heating water for cleaning purposes. It is very essential to have an abundance and to have conveniently a large supply of hot water. This seems to have been overlooked by many of the larger farm dairies where more water is needed than can be conveniently heated on a kitchen stove. To assure plenty of hot water, such dairies should be provided with a hot water or steam boiler.

CLEANLINESS IN FARM BUTTER-MAKING.

When using the term cleanliness in speaking of butter-making it means to most people simply the necessary care taken to prevent contamination during cream ripening and during the manufacture of the butter.

This subject should, however, be considered under two heads (1) cleanliness in the production and handling of the milk and cream and (2) cleanliness in the manufacture of the butter. The place and conditions for carrying out the operations under both of these heads vary considerably. A large part of the work under the first heading, cleanliness in the production and handling of the milk, particularly the milking and separating, is generally carried out by the men, while the churning of the cream and the making of the butter is more often done by the women. It is much more difficult to keep the place where the cows are kept and milked free from contaminating surroundings than the place where the butter is made, the former being done in the barn, the latter in the house or in a special room or building kept for that purpose. Considering this and also the fact that woman as a rule excels man in cleanliness, it can readily be seen that more often the conditions under which milking and separating took place than the conditions under which the butter is made, are responsible for the poor quality of butter often made on the farm.

Of all the places visited where butter was made on the farm the utensils and apparatus used in the manufacture of butter were kept in very good condition. In fact, many of the makers were exceedingly careful and exercised the utmost precautions regarding cleanliness in all operations. But few of them seem

to realize that the essential quality of the butter, the flavor, had been determined before churning was begun.

In many instances the flavor of the butter is determined in the barn by the proportion of the desirable and undesirable bacteria introduced into the milk during the milking. This is especially true of farm butter, the greater part of which is ripened without a starter. The milker, the stable, the cow, the stable air and flies are some of the greatest sources of milk contamination. Experiments show* a man working around the farm in the afternoon washed from his hands before milking 45,000,000 bacteria, yet many farmers do not think of washing their hands before starting to milk. One single hair from a cow has been known to have clinging to it several hundred bacteria. At certain seasons of the year it is very difficult to prevent a few hairs from falling into the milk. The number of bacteria on a single fly may range from 550 to 6,600,000. The stable air may not only be teeming with bacteria but may be saturated with odors from manure, cows and feed stuffs. If precautions are not taken to prevent contamination from these sources a great many bacteria necessarily get into the milk, a proportionate number of which will get into the cream. Although many bacteria which get into the milk are not detrimental, and some are beneficial to bring about the desired souring of the cream, by far the larger proportion of those associated with uncleanliness and those from the manure are very detrimental to the production of desirable butter flavors. As milk absorbs odors very readily, unclean stables with foul air also tend to produce undesirable flavors and odors in the milk. Such flavors, whether they come from bacterial action, from impurity falling directly into the milk, or from absorption, will be carried into the butter in spite of the most scrupulous cleanliness and care in the making.

To produce butter with a clean, desirable flavor it is therefore necessary not only to exercise cleanliness during the manufacture, but it is fully as essential to have the raw material, the milk and the cream, produced under cleanly conditions which means clean, well ventilated barns, free from contaminating surroundings, clean, well-groomed cows, and clean utensils.

*Storrs Agr. Exp. Sta. Bull. No. 51.

HANDLING OF CREAM BETWEEN SEPARATING AND CHURNING.

UTENSILS.

By far the most common receptacles for storing and handling the cream is the pail, the Cooley can and the eight and a half quart milk can. A great many farmers making butter do not have a business extensive enough or have conditions so that it will be practical to use a cream vat. When only small amounts of butter are made, the cream is more easily cared for in cans than in a vat. There is no objection to the use of cans for the storing of cream, but they should in all cases be kept covered. The Cooley cans are preferable to the common narrow top eight and a half quart cans, as in the latter it is difficult to properly stir the cream and as a result this very important operation is often neglected.

The cream vats found in use were either with or without jacket. It is always preferable to have a jacketed vat, as this allows for cooling cream with cold water or ice, without contaminating the cream, which is often done when ice is added directly to the cream. In most places it is necessary for the best results to use ice as the spring or well water is not always sufficiently cold in the summer to keep cream at a low enough temeprature during any extended period.

PLACE AND METHOD OF STORING CREAM.

Many farmers do not begin the ripening process of the cream until sufficient cream has been gathered for a churning. The discussion of place and method of storing cream refers to the care taken of cream from the time of separation until the ripening process is begun. It should, however, be understood that quite often when the cream is said to be stored that it is very slowly ripening.

Statistics gathered show that of the farms visited 33.3% kept the cream with ice either in a cream vat or in cans placed in a refrigerator; 4.1% kept the cream in a tub filled with running spring water; 45.8% kept the cream in cans or pails placed on the cellar floor, while 16.8% left the cream in any convenient room regardless of temperature.

Judging from the above figures, on only 37.4% of the farms visited provision was made for controlling the temperature of the cream between the time of separation until time for ripening or churning. It may have been possible in some of the best cellars to obtain fairly uniform results, but it is believed that even with the best cellars there are times during the year when the use of ice or cold spring water is necessary in order to control the temperature of cream during storage and ripening, which is necessary to produce a uniform quality of butter from day to day. In many cases the cream was stored in a refrigerator which was used for storing a variety of food stuffs. As cream absorbs odors very readily it is common to find butter with fruit or vegetable flavors, or a mixture of these and the flavors of meat, potato and other food stuffs. In addition to these individual flavors the butter would acquire the same characteristic aroma as found in such refrigerators This practice should, as far as possible, be discontinued and the "all-purpose" refrigerator for storing cream should be replaced by jacketed cream vats or some arrangement by which the cream can be kept cool in a pure air. Placing the cans in tubs or tanks of cold water is one of the simplest and most effective means for controlling temperature.

The method of storing cream in cans directly on the cellar floor does not always lead to satisfactory results. The fact that the temperature of the cellar floor as a rule is lower than the temperature of the atmosphere is no guarantee that the cellar is sufficiently cold for the storing of cream and butter. The temperature of a cellar may vary from 55° F. to as high as 75° F., depending on the time of day and the efficiency of the cellar to obtain a low temperature. In one case the temperature in the early morning was 67° F. If cream is to be stored on a cellar floor it would be well to place a thermometer where it could be easily seen and when the temperature becomes too high, above 60° F., to make other arrangements for taking proper care of the cream.

The storing of cream in the kitchen or in the living room is undesirable both from the standpoint of temperature and also from the danger of contaminating the cream with foreign odors and flavors. On one farm visited during the month of August churning was done once a week. The cream was kept in Cooley

cans in the sitting room which on the day of the visit had a temperature of 88° F. The cream as a result of being exposed to this high temperature for such a long time was exceedingly sour. The acid in the cream had precipitated the casein and large lumps of curd were found throughout the cream, especially at the bottom of the can. The cream had developed a very strong and cheesy flavor which was carried into the butter.

CREAM RIPENING.

Starters in Cream Ripening.—Although cream ripening refers to all the changes which take place in the cream when it is left in a temperature suitable for bacterial growth, the term ripening is used especially with reference to the souring of the cream. During the production and handling of the milk and cream as previously discussed under "Cleanliness and Storing of Cream," it has been desirable not only to prevent bacteria from getting into the milk and cream but also to prevent their growth. When it is desired to begin the ripening process the bacteria in the cream must be given a chance to grow and multiply. The object of this bacterial growth is to produce the aroma and flavor in the butter, increase the churnability of the cream and to improve the keeping quality of the butter.

Since the flavor of the butter is dependent upon the ripening of the cream, it can easily be understood that the ripening of cream is one of the very important parts of farm butter-making. The best cream may be entirely spoiled by improper or careless ripening. It must not be understood, however, that carelessness during milking or in the handling of the cream previous to ripening, introducing great numbers of undesirable bacteria, can be overcome by proper ripening.

Cream ripening is not only important from the standpoint of the quality of the butter, but it is one of the most difficult parts of butter-making to carry out properly and successfully under farm conditions, due principally to a lack of facilities, especially lack of proper equipment and arrangement for the control of temperature. The success or failure in cream ripening depends principally upon two factors, firstly the number of the different kinds of bacteria in the cream and secondly the ripening temperature.

Bacteria in the Cream.—As has already been stated, some bacteria are desirable and necessary in cream ripening, while others are detrimental. The desirable bacteria get into the cream in two ways; they are either introduced by nature or by man. Fortunately, the bacteria which produce the desirable flavor Nature generally suplies in the cream in greatest numbers, provided the milking and care of the milk and cream has been carried out under cleanly conditions. When the desirable bacteria are introduced into the cream by man, the cream is then ripened by what is termed a *starter*. The use of starters has become quite common in creamery butter-making, and is in fact necessary in many cases to produce a uniform quality of butter. On the farm, where the butter-maker has control of the milk from the time it leaves the cow, starters are seldom necessary and are only to be recommended in special cases. To successfully handle a starter from day to day means much extra labor. It necessitates good equipment, a ready supply of boiling water or steam, good facilities for controlling temperatures while the starter is ripening, as well as facilities for keeping the starter at a temperature below 55° F. after it is ripe until it is needed. Furthermore, it requires a general knowledge of bacteria, of conditions favorable and unfavorable to their growth, and of the many sources from which milk can become contaminated. It also requires thorough appreciation of what cleanliness means and of the fact that bacteria, although invisible, are found everywhere. An object may look ever so clean but still be covered with millions of bacteria. The fact that on the farm butter is often made only every second, third or fourth day makes the use of starters still more difficult. Considering the question of starters for New Hampshire conditions from the above standpoint they can not be generally recommended. There are times, however, when starters are necessary, as for instance when the cream will not sour or when undesirable bacteria have become so numerous on the dairy utensils and in the dairy room that they control the ripening from day to day. Also on some of the largest and best equipped dairy farms starters undoubtedly could be used successfully and be a means for obtaining a more uniform and better flavored butter.

There are two kinds of starters, home made and commercial.

To make a homemade starter, select the milk from one or more cows which have been fresh within the last three months. After securing the milk under as cleanly conditions as possible it is placed in covered glass fruit jars or bottles. These receptacles should have been previously cleaned and then sterilized by placing them in water and bringing the water to a boil. The milk is now placed at a temperature between 70° F. and 75° F. until curdled. The sample which curdles with a smooth, uniform, solid curd, free from air holes and undesirable taints, but with a clean sour taste and smell, is selected for further use. The amount of starter needed depends upon the amount of cream, the ripening temperature and the condition of the cream; as a rule ten per cent. or one quart of starter for every ten quarts of sweet cream is sufficient. It is therefore necessary to introduce the pint of sour milk obtained as described above into a quantity of boiled skim milk cooled to 65° F. and which is sufficient for the amount of cream on hand to be ripened. When this second lot sours after being kept at a temperature of about 70° F. it is introduced into the cream and the ripening process is begun. The starter can thus be carried on from day to day by saving a small part of the starter which is ready for use and introducing it into a new lot of skim milk. A starter should not be used before it curdles. If it curdles before needed it should be immediately cooled below 55° F. In the handling of starters as well as in cream ripening the butter-maker must plan his work, use his judgment and experiment until he finds the best time, place and temperature for setting his starter so it will become ripe and ready for use at the proper time.

The buttermilk from a previous churning may be used with good results as a starter as long as it has a clean sour taste and is producing the desirable flavor in the butter. If the buttermilk is not added to the cream when fresh it should be cooled below 55° F. until needed. If at any time the buttermilk fails to produce the desirable souring of the cream, its use should be discontinued at once, as any fault the butter may have received from improper ripening will be carried into the next lot through the buttermilk. In such cases it is necessary to give all utensils a thorough scalding and try to get the desirable bacteria in control either by using a home-made starter or by introducing into

the cream a small quantity of fresh buttermilk with a clean sour taste, obtained from a neighboring farm.

The commercial starter or butter culture differs from a natural starter principally in its origin or the manner in which the first batch of sour milk is obtained. In the former the desirable bacteria are selected, propagated and put up in small packages in special laboratories and bought by the butter-maker, while in the latter the butter-maker is doing his own selection, depending on Nature to furnish under normal conditions a large number of desirable bacteria. As it is considered impractical, with a few exceptions, to recommend the use of commercial cultures in farm butter-making, and since a full description of handling can be obtained from the manufacturer, it would seem needless to further discuss their use at this time.

Methods of Ripening.—There are two common methods of cream ripening in vogue among New Hampshire farmers.

1. Ripening during the entire period between churnings.
2. Cooling the cream at once after separations and ripening for a period of from 12 to 36 hours.

To say which of the two methods gives the better results is quite difficult, as it depends somewhat upon the frequency of churning, the facilities and the equipment on hand. More important than the method is the man, as it was noticed that both good and bad results were obtained with both methods. It is believed where churning is done every other day or oftener a slow, continuous ripening is most desirable, while in case churning is done only once or twice a week better results are obtained by cooling the cream immediately after each separation and ripening it just before churning.

The Ripening Temperature of Cream.—On most of the farms visited the ripening temperature was entirely a matter of chance. Sixty-eight per cent. reported the temperature as variable, depending on that of the room or cellar in which the cream was ripened; 6.3% preferred a temperature between 55° and 60° F.; 22% a temperature of from 60° to 70°; while 3.7% wanted a temperature between 78° and 80°. Altogether too little attention is paid to the ripening temperature. Many farmers did not even have a thermometer and some of those who had did not use it often enough. When sufficient acid can be

developed in the cream by ripening at a temperature between 60° and 70° F. this range of temperature is to be recommended. At this temperature the lactic acid bacteria or those which tend to develop good flavors and aroma in the butter multiply comparatively faster than other bacteria, enabling the farmer to check and overcome the growth of the latter. It is, therefore, possible to get desirable flavors developed in cream which perchance had a small majority of undesirable bacteria, by keeping the temperature within this range and as near as possible 65° F. while the same cream left to ripen at a higher temperature would produce undesirable flavors. When the temperature is lower than 60° the lactic acid producing bacteria grow and multiply very slowly and it is therefore difficult to get the cream sufficiently sour for churning. Furthermore, a class of bacteria which produces bitter flavors grow quite well at a temperature between 50° and 60° F. and as a result cream which has been kept for several days at this temperaure often has a decidedly bitter taste.

While the ripening of the cream takes place it should be stirred frequently to keep the bacteria evenly distributed, to keep the cream uniform in temperature and to keep the fat evenly distributed. These factors tend to give a uniform souring of the cream.

Degree of Ripeness.—Remembering that the ripening of cream is done principally to produce flavor, the question arises, how much flavor is it desirable to produce, or, in other words, how sour is it desirable to have the cream? A great deal of farm butter has too much flavor, due to not having the right kind of bacteria in control from the beginning.

The degree to which the cream is ripened on New Hampshire farms varied considerably; 4.2% churned sweet cream, 91.7% had the cream moderately sour and 4.1% had the cream very sour before churning. When sour cream butter is made the cream is ready to churn when it has a mild but distinctly sour taste, not too sharp or bitter, and has a glossy, brittle appearance. There are two common methods in use for ascertaining when the cream is ready for churning, first by using the acid test and second by taste and aroma. The acid test consists of measuring by means of an alkali solution of known strength the amount of

acid in the cream. The common way, however, to judge of the ripeness of cream on the farm is by the taste, aroma and appearance. When considering the taste, aroma and appearance of cream it is very difficult to describe or establish a standard which will be understood by all, as ideas differ in regard to what constitutes mildly sour, sour or very sour cream. This was noted in the field work as farmers whose cream was exceedingly sour did not consider it so. Some of the buttermakers expressed the opinion that the sourer the cream was the easier it churned and the more butter was obtained, and therefore the cream could not be too sour. The difference in the amount of butter obtained and the difference in time it takes to churn cream which is slightly sour and cream which is very sour is very small, in fact it is so small that it is unprofitable and unwise to sacrifice quality for quantity. In considering the degree of ripeness, it should be considered that too sour cream as a rule gives a butter with a strong flavor and with poor keeping qualities and therefore the danger of getting the cream too sour before churning is greater than not getting it sour enough.

CHURNING.

Temperature.—The churning temperature is a very important factor in buttermaking, for upon it depends the texture or body of the butter, its keeping qualities, and the losses of fat in buttermilk. If the temperature is too high the butter will come soft and will have a greasy texture, it gathers very quickly into large lumps and incorporates large amounts of buttermilk which upon standing will cause a rapid deterioration in the butter. A high temperature also causes a serious loss of fat in the buttermilk as the butter gathers too quickly to allow a thorough churning. If, on the other hand, the churning temperature is too low it will often take a long time to churn. The cream at a low temperature is quite viscous and incorporates air readily, sometimes filling the churn and thus preventing proper agitation of the cream. The butter, when it comes, often appears in very small, hard granules which gather with difficulty. If the butter is worked while in this condition it often results that it will have a crumbly texture and a very low water content.

The following churning temperatures were noted on New Hampshire farms:

Churning temperature	56°	58°	59°	60°	61°	62°	67°	78°
Percentage of farmers using	7.1%	14.3%	14.3%	29.%	7.1%	22.%	8.%	5.3%

The above table shows the churning temperature to vary from 56° F. to 78°F., a variation of 22° F. This does not necessarily indicate that some farmers were churning at too high and others at too low a temperature, but this may be due to a difference in condition. It explains the difficulty in answering the question, "What is the best churning temperature?" which is so frequently asked in discussing the subject of farm butter-making. Each individual must work out for himself the churning temperature which is best suited to his conditions, taking into consideration the following factors:

1. Length of time of churning.
2. Condition of butter when it comes.
3. Loss of fat in buttermilk.

To obtain the best results the temperature should be regulated so that the cream will churn in about 30 to 40 minutes. It is the opinion of many people that the shorter time in which churning is done the better. Special churns are put on the market advertised to churn butter in five minutes. Under no conditions can it be recommended to try to get butter in so short a time as it can be done only at a sacrifice of quality of the butter and excessive loss in the buttermilk.

The condition of the butter when churning is completed, like the time of churning, is very largely dependent upon the temperature of the cream. The temperature should be regulated so that the butter will come in a firm condition, not too soft nor too hard.

As has been stated previously, if the churning temperature is too high there will be an excessive loss in the buttermilk. If a Babcock tester is not available, the appearance of the buttermilk will serve as a guide to its richness. If churning is completed in a short time, less than twenty minutes, and the buttermilk looks rather thick and creamy, it will contain an excess of fat. If churning is completed in thirty minutes or more the butter-

milk as a rule looks thin and bluish, showing thorough churning. On one farm the churning temperature was 78° F., the time of churning twelve minutes and the loss of fat in the buttermilk was 0.95%. Another place the churning temperature was 67° F., the time of churning eight minutes, the loss of fat in buttermilk 1.5%. 0.2% is considered a normal loss of fat in buttermilk. In the first case the loss was four and one-half times and in the second case seven and one-half times more than normal.

Such excessive losses can be avoided by a daily comparison of the factors mentioned above, especially the churning temperature, as upon it depends very largely the time of churning and the loss of fat in the buttermilk.

Straining of Cream.—The straining of the cream into the churn is a practice which is not common among the New Hampshire farm butter-makers, as only one farm in ninety was found to make use of the strainer. Straining of cream into the churn should be more extensively used, as it takes very little time and adds very little expense to the farm butter-making operation. The value of straining lies in that it removes undesirable substances from the cream which if left would detract from the appearance and quality of the butter. Cream when sour sometimes contains small lumps of curd. These lumps, if not removed by straining, will be carried into the butter. As the lumps of curd always are whiter than the butter, whether butter color is used or not, they appear as white specks and detract from the appearance of the butter, and also impair its keeping quality. Even with the best care accidents will happen. It is not uncommon to find that a few flies, smaller insects, or some solid impurities have fallen into the cream. In one case even a mouse has been found in the cream can. If the cream is not strained such impurities may easily escape notice and perhaps ruin a churning of butter.

When to stop Churning.—The old practice, and one which still is followed by some, was to gather the butter in the buttermilk. By this method a great deal of buttermilk is introduced into the butter, giving it a poor flavor and very poor keeping qualities. It is best to stop churning when the butter granules are about the size of wheat kernels or small kernels of corn. If the butter is in this condition, less buttermilk will be incorpo-

rated, as the wash water will come in contact with a much greater surface of the butter. When the churning temperature is too high, the butter gathers very quickly into lumps and it is very difficult to prevent the incorporation of large amounts of buttermilk. It was also noticed that in the old types of dasher churns the butter is very easily churned too much unless great care is exercised.

Some people use the appearance of the buttermilk, a thin, whitish color being an index, as the time to stop churning. To go by this alone is not safe, for if a high churning temperature is employed the buttermilk will not take on this appearance.

The objection to stopping churning when the butter granules are too small is that the minute butter granules may pass through the strainer and be lost in the buttermilk.

Washing the Butter.—Only pure well or spring water should be used for washing the butter. If the buttermilk is well drained from the butter, one washing, filling the churns at least as full of water as it was of cream when churning was begun, is sufficient. If for any reason the first wash water looks milky, a second washing may be necessary. In one case observed the butter was churned in the buttermilk until it was gathered into a few large lumps. It was washed in three sets of water. One washing would have been equally as beneficial, as it removed all the buttermilk clinging to the outside of the large lumps of butter and any amount of washing could not remove the buttermilk which had been incorporated.

One very important factor to be considered in washing the butter is the temperature of the water. If the churning temperature has been right and the butter has come in good condition, the temperature of the wash water should be the same as that of the buttermilk. If the butter comes soft, it may be necessary to use a lower temperature and if too hard a higher temperature. Extremes should be avoided in all cases, as too warm water will cause a soft and greasy butter, while too cold water will make the butter appear brittle and tallowy and cause difficulty in getting the salt well dissolved.

Salting and Working.—As a rule one ounce of salt to each pound of butter is sufficient. The use of cheap, coarse salt should be avoided, as it often contains chemical impurities and

dissolves with difficulty. The salt must be stored in a clean, dry place, as it readily absorbs moisture and foreign odors from the air.

The object of working butter is to uniformly distribute the salt and give the butter a plastic consistency. Several butter-makers believed that he chief if not the sole purpose is to work out the buttermilk or water and with that in view worked the butter from four to six times before adding the salt. In one dairy the roller was passed over the butter twenty times before the salt was added; as a result the grain of the butter was entirely destroyed, giving it an oily and greasy appearance. Too much water was expelled before the salt was added, making the salt dissolve with difficulty and giving the butter a low water content, decreasing the yield of butter.

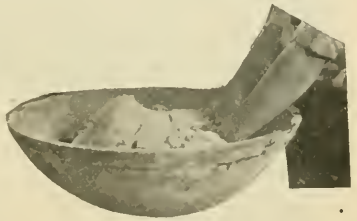

Fig. 4. An unsanitary, unsatisfactory method of working butter.

The old primitive method of working the butter by the hands was still found in use in places. On one farm where from fifty to sixty-five pounds of butter were made per week this method was still in vogue. It is very undesirable in all cases to get the hands directly in contact with the butter. It is not only highly unsanitary, but it spoils both the grain of the butter and its appearance. The melting point of butter fat varies from 93° F. to 98° F. Our body temperature is about 98.6° F. When the hands come in contact with the butter it melts, making it oily and greasy, at the same time giving it a dead, dirty grey color. Many farmers making only a small amount of butter used a bowl and paddle, which is a great deal better than using the hands, although not as satisfactory as a small table worker.

It is well to add the salt before working is begun, while the butter is still in a granular condition. A practice which is frequently followed and which is very satisfactory is to pass the roller over the butter once, apply one half the salt, turn the butter over, pass the roller over again, and add the balance of the salt. By so doing it is possible to get the salt evenly distributed with a minimum amount of working. It is impossible to lay

down a hard and fast rule in regard to the amount of working to give butter, as this depends upon its conditon. If the butter is firm it will stand more working than when soft without being over worked. Let it be borne in mind that the butter is worked to evenly distribute and dissolve the salt and to bring it into a proper consistency. It is therefore necessary for the operator to taste the butter at intervals during working, to ascertain the condition of the salt and to watch the appearance of the butter. If the butter should begin to appear greasy before the salt is properly dissolved and evenly incorporated it is well to leave the butter standing in a cool place for about an hour before working is finished. If left over night, as was observed in some instances, guard against letting the butter get too hard before working the second time, as too much water will be expelled, making the butter dry and crumbly and also lowering the yield.

Fig. 5. A clean, convenient method of working butter.

PACKING AND MARKETING.

With the exception of a few parties marketing their butter in five-pound boxes and twenty-pound tubs, nearly all the butter in the state is marketerd in one pound or in half-pound prints. Too much ean not be said of the value of the appearance of the butter as a factor in determining its priee. There is no doubt as to which attracts the most favorable attention of the buyer and which will sell the easier of two pounds of butter, one packed in a neat and attractive way or one packed in a slovenly and careless manner. Even butter of poorer quality but neatly and attractively packed often sells the higher. To add to the attractiveness of the butter the bottom of the mould is often earved in faney figures or monograms. It is very desirable to have some

mark on a butter package, as besides making it more attractive this also gives the butter individuality and helps the seller to find a permanent market. Too much carving of the mould is, however, undesirable as it makes the mould difficult to clean and also less durable. These objections can be avoided if instead of carving the mould, a neat design is printed on the wrapping paper which will have the same general effect and be more attractive.

In several places the butter was rolled into balls and pressed into the mould with the bare hands. The only reason given for this method of procedure was that it was quicker and easier than to handle the butter with ladles. If a person has never used ladles for packing, it may at first seem awkward, but with a little practice it soon becomes as easy and is much to be preferred to using the hands, the objections to which have already been given under "Working of Butter."

It was found that cakes which were sold for a pound in some cases weighed less and in others more, the variation being as much as two ounces. It is unlawful to sell fourteen ounces for a pound and it is poor business management to give eighteen ounces when sixteen is asked for. On one farm selling an average of fifty-six pounds per week the farmer was giving away seven pounds per week, which at thirty cents amounted to $2.10, or $109.20 for the year. When packing butter in moulds the prints should therefore be weighed occasionally to assure a standard weight. This is especially necessary when a new mould is put into use, as this will expand in boiling water and the composition of the butter to be packed may vary from that from which the mould was standardized.

There are four distinct markets for dairy butter in this state, which rank in importance in order mentioned.

1. Private customers.
2. Local stores.
3. City markets.
4. Commission houses.

Many farmers located near a town or city are able to find private customers for their butter as well as other farm products. The advantage of the special market is that a higher price as a

rule is obtained for the product, as the middle man is eliminated and there is no bartering. New Hampshire with its large city population offers special opportunities to the farmer for finding or creating special markets for dairy products. The fact that so many city people spend part of the summer in the country, thus having an opportunity of becoming acquainted with the product of the farm, offers opportunities to the farmer for obtaining special markets which are hardly equaled outside of the New England states. The demand for uniform, good butter is greater than the supply. This does not mean that the consumers are scouring the country and offering high prices for butter, but it means that the producer can readily find a market for his product if he will search for it. First of all he must let the people know that he has butter to sell. For the man who expects to carry on a permanent business, a few dollars used in judicious advertising are as a rule well spent. The cheapest and most effective method of advertising to-day is the printed page. As the market within reach of a particular farmer is more or less local and his supply limited, an extensive system of advertising would prove unprofitable. The use of postal cards, letterheads, printed wrapping paper, advertisements in local papers, and the distribution of hand bills, are cheap and effective methods of advertising which can be used to advantage. There are a number of dairies in New Hampshire that have been successful in obtaining considerably above the average price paid for butter. This is not always accomplished in a day, but is the result of a careful and persistent study of the locality, likes and dislikes of their customers and of their power and willingness to pay a high price for the product. It is the result of making a uniform grade of butter, having a uniform supply for the year and keeping it well advertised.

Farmers who are located so that it is impossible or unprofitable for them to deliver the butter directly to the consumer can find a market through the local stores. The advantage of this market is that it saves time in delivering and in finding customers for the butter. The disadvantage lies in the fact that the price is generally from two to five cents less per pound and in addition the farmer is expected to buy products if not for the full amount of the butter, at least for a large share.

Where the local price for farm butter is low, due to a large supply or poor markets, the city offers a market. Many city stores can handle good butter to better advantage than a town store. In several instances it was found that farmers were marketing butter through the city stores, receiving thirty to thirty-three cents a pound delivered at the nearest railroad station.

A few farmers were visited who marketed their butter through commission houses. This is the least profitable method for disposing of butter, as it often requires two middlemen before it reaches the consumer. The commission and express generally amount to from one and three-quarters cents to two and one-half cents per pound. The returns to the producer will vary from six to eight cents less per pound than when sold to stores.

Fig. 6.

YIELD OF BUTTER.

To obtain data on the yield of butter obtained under farm conditions records as tabulated below were kept of ten churnings on different farms. In no case was suggestion given by the representative from the station until churning was completed.

The term "overrun" is commonly used to express the yield of butter. To find the overrun, as for instance in the case of churning No. 1 in the above table: Subtract the amount of

TABLE 11.— *Records of ten churnings from ten different farms.*

No. of churning.	Pounds of cream.	Per cent. of fat in cream.	Pounds of fat in cream.	Churning temperature.	Time of churning in minutes.	Condition of butter at end of churning.	Temperature of buttermilk.	Temperature of wash water.	Butter worked once or twice.	Per cent. of fat in buttermilk.	Amount of butter churned.	Per cent. of overrun.	Remarks.
1	43	25	10.75	60°	15	Soft	64	50	twice	1	11.25	4.7	
2	79	32	25.3	59	40	Firm granular	64	64	once	.08	27.5	9	
3	40	33	13.2	59	12	Slightly soft	60	56	once	.95	15	12	
4	44.5	39	17.36	62	20	Slightly soft	63	.....	once	.47	19.5	12.7	
5	667.5	20	135.4	62	45	Firm, small granules	62	64	once	.06	153	13.9	
6	74	34.5	25.5	58	55	Firm, small granules	60	60	once	.05	29	15.7	
7	35	37	12.9	62	15	Soft, large lumps	63	65	once	1	15	16.3	
8	80	25.5	20.4	60	40	Firm, large granules	62	.....	once	.05	24	17.6	
9	24	31.2	7.57	60	55	Soft	63	60	once	1	9	18.7	Churn too full.
10	76.2	29	22.1	74	12	Very soft, large lumps	74	42	once	.95	26.25	19	A great deal of buttermilk incorporated.
Av.	116.3	24.97	29	.....	.....	....	.....	.....	.....	.56	32.95	13.4	

butter fat from the amount of butter made (11.25–10.75=0.5). .5 of a pound represents the gain in weight in the finished butter on 10.75 pounds of fat determined from a Babcock test of cream. On 100 pounds of fat, or expressed in percentage the overrun would be (.5÷10.75) 100=4.7%.

In estimating butter from butterfat it is generally figured that one pound of fat represents 1 1-6 pounds of butter, or an overrun of 16.4%. It will be noticed from the table that in actual practice only four out of ten obtained this amount even when the losses in skimming were not considered.

It is impossible to draw accurate conclusions as to the low yield of butter from a summary of the above records as each churning is made under widely different conditions. In studying the table, each churning should therefore be studied separately rather than drawing conclusions from average results.

The amount of butter which is obtained from a given quantity of butterfat in milk depends upon (1) the losses of fat in skim and buttermilk, (2) losses in milk, cream and butter in handling, and (3) the composition of the butter.

LOSSES OF FAT IN BUTTERMILK.

One factor which stands out prominently, considering the ten churnings, is the relation between the churning temperature, the length of time it takes, and the loss in the butter-milk as shown by the following table.

TABLE III.—*Showing relation between churning temperature, time of churning, and loss of fat in the buttermilk.*

No. of churning.	Churning temperature.	Time of churning.	Loss in buttermilk.	No. of churning.	Churning temperature.	Time of churning.	Loss in buttermilk.
1	60°	15″	1	2	59°	46″	.08
3	59	12	.95	5	62	45	.06
4	62	20	.47	6	58	55	.05
7	62	15	1	8	60	40	.05
10	74	12	.95	9	60	55	1.
Av. of 5 churning..	63.4	14.8	.874	Av. of 5 churning..	59.8	45	.248

This table shows the time of churning to be about three times shorter, but the losses in the buttermilk to be 3.5 times greater in case of the higher churning temperature.

There is, however, not always a direct relation between the length of time it takes to churn and the loss in the buttermilk, as several other factors besides the churning temperature may influence the length of time of churning. In churning No. 9, the time of churning was 55 minutes, and still the loss in the buttermilk was 1%; the churn in this case being too full prevented proper agitation of the cream and prolonged the churning. An excessive loss in buttermilk reduces the yield of butter. In case of churning No. 9, however, it is found that the loss in the buttermilk was 1% and the overrun 18.7, while churning No. 5 shows a loss of only .06% of fat in the buttermilk with an overrun of 13.9%. The reason for the higher overrun in churning No. 9, which at the same time shows the greater loss of fat in the buttermilk, is due to the butter being soft, gathering in large lumps and incorporating large amounts of buttermilk.

There is no doubt that the churning temperature employed in farm butter-making in a great many cases is too high, not only causing an excessive loss of fat in the buttermilk, reducing the yield, but it also results in a poorer quality of butter both regards flavor and texture.

LOSSES IN HANDLING.

During separating and churning and in the handling of the butter, there is a loss of butterfat in milk, cream and butter, adhering to cans and other utensils with which it comes in contact. The smaller the amount of butter made each time, other factors being equal, the smaller the overrun, as there are certain losses in handling which practically remain constant and thus the percentage loss of butter fat on a small is greater than on a large churning.

COMPOSITION OF BUTTER.

TABLE IV.— *Showing the lowest, highest and average composition of ten samples of New Hampshire creamery butter.*

	Lowest	Highest	Average
Water	7.22	15.62	11.25
Fat	78.88	88.41	84.38
Casein	1.03	3.32	1.80
Salt	1.34	4.16	2.57

The constituents of butter will vary according to the methods employed in its manufacture. When the water, casein and salt in the butter is increased the amount of fat used for each pound is decreased and consequently the overrun will be increased.

Over-churning in the buttermilk or in the wash water, high temperatures of churning or of the wash water making the butter soft, tend to increase the water content of the butter.

When the butter appears in hard, fine granules, either from churning too cold or using too cold wash water, the tendency is to decrease the water content. The same is true when butter is worked excessively or worked when too hard.

The amount of casein in the butter depends primarily upon the amount of buttermilk incorporated. High churning temperature, churning the butter into large lumps in the buttermilk, and insufficient washing, will increase the amount of casein. Old, very sour cream also tends to produce butter high in casein.

The percentage of salt in the butter depends upon the amount added and the amount retained. The amount retained depends primarily upon the amount of water lost during working.

It was the opinion of several butter makers visited that the drier the butter was worked the better the butter. On the contrary, butter with too low a water content lacks palatability. It is too gummy and lacks the easy melting quality in the mouth which is so characteristic of the finest butter. The law allows sixteen per cent. of water in butter, and the butter-maker should aim both from the standpoint of quality and profit to get about fourteen per cent. of water in the butter. There is little danger in farm butter making of exceeding the limit of sixteen per cent. water except in cases when the butter is churned into too large lumps in the buttermilk or in the wash water.

SUMMARY.

A study of the farm butter-making conditions as presented in this bulletin lead to the following conclusions:—

1. A large quantity of butter is still made on New Hampshire farms, principally due to, (1) poor transportation facilities, making it difficult to ship milk; (2) a widely scattered population, making creameries difficult to operate; (3) the small dairy herds kept; and (4) a special demand for good dairy butter at high prices.

2. The demand in nearly all localities is greater than the supply.

3. The price obtained for butter varies from 20 to 40 cents per pound, with an average price for the state of 28.5 cents.

4. The cost of equipment varies from $15 to $600, the most common cost varying from $90 to $150.

5. A good deal of the farm butter made, altho often selling for a high price, is of low grade, especially lacking in uniformity and keeping quality The principal reasons being:

a. Lack of equipment, especially in the way of suitable building or specially equipped rooms. Only eight per cent. of the farms visited had a special room or building used exclusively for the dairy work.

b. Lack of cleanliness in the stables and during milking. In a number of cases people did not realize that the care and cleanliness exercised in the stable and during milking is fully as essential to the production of good butter as the care and cleanliness exercised in the manufacture of the butter.

c. Insufficient control of temperature. Only 33.3 per cent. of the buttermakers made provision for ice, 4.1 per cent. had running spring water, while the rest had no means of regulating the temperature of the cream during storing and ripening, nor the temperature of the wash water. Altogether too little use was made of the thermometer.

d. Cream too old and too sour. Reports received from buttermakers show that 25.8 churned once, 58.4 twice, 11.2 per cent. three times, and 4.6 per cent. either four or six times a week. It is exceedingly difficult to make good butter when churning is done only once a week, as the cream gets too old and often too sour before churning. It is recommended to churn at least twice a week, and even then it is necessary to be able to control the temperatures of the cream either by using ice or cold spring water in order to make good butter.

e. Too high churning temperature. The churning temperature being too high is often responsible for the dull appearance, poor body and poor keeping quality of the butter, and also for an excessive loss in the buttermilk. Losses in buttermilk varied from .05 to 1.5 per cent.

f. Overchurning and overworking. By churning the butter into large lumps, a great deal of buttermilk is incorporated, causing a rapid deterioration of the butter. Overworking, altho not as commonly practiced, tends to give the butter a dead, worn appearance and a poor body. In no case should the hands touch the butter during working and packing.

6. The overrun (pounds of finished butter in excess of pounds of butterfat) varied from 4.7 per cent. to 19 per cent. with an average of 13.4, which is 3 per cent. below the estimated amount of 16.4 per cent. or 1 1-6 pounds of butter from each pound of butterfat.

7. The most common defects in farm butter are (1) rancidity, due to the cream's being too old or sour, too high ripening temperature, or the butter's not being sufficiently protected from heat and light and (2) poor flavors, absorbed by the cream, during storing and ripening, and by the butter when kept near strong smelling food stuffs, (3) mottles, as a result of too much buttermilk being incorporated, the action of the caseln on the salt producing the uneven color.

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